

WHAT IS CLAIMED IS:

1. A fuel reforming apparatus for generating hydrogen by reforming reaction, comprising:

5 a premixed fuel storing portion which includes mixture state stabilizing means for maintaining a state in which reformed fuel and water that are to be supplied for the reforming reaction are mixed evenly, and stores the reformed fuel and the water as premixed fuel formed by mixing the reformed fuel and the water substantially evenly by the mixture state stabilizing means;

10 a reformer which includes a reforming catalyst for promoting the reforming reaction; and

a premixed fuel supplying portion which supplies the reformer with the premixed fuel stored in the premixed fuel storing portion.

15 2. The fuel reforming apparatus according to claim 1, wherein the reformed fuel is hydrophobic liquid hydrocarbon.

3. The fuel reforming apparatus according to claim 1, wherein the mixture state stabilizing means is provided with an emulsifier which is mixed in the premixed fuel, and which makes the reformed fuel and the water stable emulsion.

20 4. The fuel reforming apparatus according to claim 1, wherein the mixture state stabilizing means includes an agitating portion for agitating the reformed fuel and the water physically.

25 5. The fuel reforming apparatus according to claim 1, wherein the premixed fuel supplying portion includes:

a vaporizing portion which is a predetermined space communicating with the reformer;

30 a heating portion which supplies the vaporizing portion with heat for enabling the premixed fuel to be vaporized; and

a spraying portion which sprays the premixed fuel stored in the premixed fuel storing portion into the vaporizing portion.

5 6. The fuel reforming apparatus according to claim 5, wherein the premixed fuel supplying portion includes a premixed fuel temperature increasing portion which increases a temperature of the premixed fuel using heat of the gas containing hydrogen, generated by the reforming reaction before spraying the premixed fuel into the vaporizing portion.

10 7. The fuel reforming apparatus according to claim 1, further comprising:

 an independent material supplying portion which supplies the reformer with independent material that contains one of the reformed fuel and the water and that does not contain the other, independently of the premixed fuel
15 supplying portion.

 8. The fuel reforming apparatus according to claim 7, wherein the independent material contains water, and the water contains water generated in a system including the fuel reforming apparatus.

20 9. The fuel reforming apparatus according to claim 8, wherein the independent material supplying portion includes:

 a gas supplying portion which supplies the reformer with gas containing oxygen; and

25 a humidifying portion which adds the water generated in the system in a form of steam to the gas containing oxygen, that is to be supplied by the gas supplying portion to the reformer.

 10. The fuel reforming apparatus according to claim 9, wherein the
30 humidifying portion includes:

 a first passag through which the gas containing oxygen flows;

a second passage through which the water generated in the system flows in a form of steam; and

5 a hydrogen permeable membrane which is provided between the first passage and the second passage, and through which steam permeates from a side in which steam partial pressure high to a side in which steam partial pressure is low.

10 11. The fuel reforming apparatus according to claim 1, wherein the premixed fuel storing portion makes a ratio of the number of molecules of the water in the premixed fuel with respect to the number of carbon atoms in the reformed fuel at least 0.5.

15 12. The fuel reforming apparatus according to claim 1, wherein the premixed fuel storing portion makes a ratio of the number of molecules of the water in the premixed fuel with respect to the number of carbon atoms in the reformed fuel at most 1.0.

13. The fuel reforming apparatus according to claim 1, wherein the premixed fuel supplying portion includes:

20 a premixed fuel temperature increasing portion which increases a temperature of the premixed fuel stored in the premixed fuel storing portion using heat of gas containing the hydrogen generated by the reforming reaction; and

a vaporizing portion which vaporizes the premixed fuel whose temperature has been increased in the premixed fuel temperature increasing portion before supplying the premixed fuel to the reformer.

25 14. A fuel cell system, comprising:

the fuel reforming apparatus according to claim 1; and
a fuel cell which generates an electromotive force by an electrochemical reaction using hydrogen generated in the fuel reforming apparatus.

30 15. A fuel cell system, comprising:

the fuel reforming apparatus according to claim 8; and
a fuel cell which generates an electromotive force by an
electrochemical reaction using hydrogen generated in the fuel reforming apparatus,
wherein the water supplied from the independent material supplying
5 portion contains water generated in the fuel cell.

16. The fuel cell system according to claim 15, wherein the water supplied
from the independent material supplying portion contains water in exhaust gas
emitted from an anode side of the fuel cell.

10 17. The fuel cell system according to claim 15, wherein the water supplied
from the independent material supplying portion contains water in exhaust gas
emitted from a cathode side of the fuel cell.

15 18. The fuel cell system according to claim 15, further comprising:

a first combustion portion which burns hydrogen that remains in
exhaust gas emitted from an anode of the fuel cell, wherein the water supplied from
the independent material supplying portion contains water generated in the first
combustion portion.

20 19. The fuel cell system according to claim 15, further comprising:

a hydrogen separating portion which includes a hydrogen permeable
membrane that selectively makes hydrogen permeate therethrough, and which
separates hydrogen in gas emitted from the fuel reforming apparatus using the
25 hydrogen permeable membrane;

a hydrogen supplying portion which supplies the fuel cell with the
hydrogen separated in the hydrogen separating portion; and

30 a second combustion portion which burns gas that remains after
separation of hydrogen in the hydrogen separating portion, wherein the water supplied
from the independent material supplying portion contains water generated in the
second combustion portion.

20. A fuel cell system, comprising:

the fuel reforming apparatus according to claim 6; and
a fuel cell which generates an electromotive force by an
electrochemical reaction, wherein the fuel reforming apparatus includes a hydrogen
extracting portion having a hydrogen permeable membrane which selectively makes
5 hydrogen permeate therethrough, and extracts hydrogen from gas containing hydrogen
using the hydrogen permeable membrane by being supplied with the gas containing
hydrogen generated in the reformer, and operates at a temperature that is higher than
that of the fuel cell, and the premixed fuel temperature increasing portion increases a
temperature of the premixed fuel using the hydrogen extracted by the hydrogen
10 extracting portion, and supplies the hydrogen used for increasing the premixed fuel
for the electrochemical reaction in the fuel cell.

21. the fuel reforming apparatus according to claim 13; and
a fuel cell which generates an electromotive force by an
15 electrochemical reaction, wherein the fuel reforming apparatus includes a hydrogen
extracting portion having a hydrogen permeable membrane which selectively makes
hydrogen permeate therethrough, and extracts hydrogen from gas containing hydrogen
using the hydrogen permeable membrane by being supplied with the gas containing
hydrogen generated in the reformer, and operates at a temperature that is higher than
20 that of the fuel cell, and the premixed fuel temperature increasing portion increases a
temperature of the premixed fuel using the hydrogen extracted by the hydrogen
extracting portion, and supplies the hydrogen used for increasing the premixed fuel
for the electrochemical reaction in the fuel cell.

25 22. A fuel reforming apparatus for generating hydrogen by reforming
reaction, comprising:
a premixed fuel storing portion which includes an additive agent
maintaining a state in which reformed fuel and water that are to be supplied for the
reforming reaction are mixed evenly, and stores the reformed fuel and the water as
30 premixed fuel formed by mixing the reformed fuel and the water substantially evenly
by the additive agent;
a reformer which includes a reforming catalyst for promoting the
reforming reaction; and
a premixed fuel supplying portion which supplies the reformer with
35 the premixed fuel stored in the premixed fuel storing portion.

23. The fuel reforming apparatus according to claim 22, wherein the reformed fuel is hydrophobic liquid hydrocarbon.

5 24. The fuel reforming apparatus according to claim 22, wherein the additive agent is an emulsifier which is mixed in the premixed fuel, and which makes the reformed fuel and the water stable emulsion.

10 25. The fuel reforming apparatus according to claim 22, wherein the premixed fuel supplying portion includes:

a vaporizing portion which is a predetermined space communicating with the reformer;

a heating portion which supplies the vaporizing portion with heat for enabling the premixed fuel to be vaporized; and

15 a spraying portion which sprays the premixed fuel stored in the premixed fuel storing portion into the vaporizing portion.

20 26. The fuel reforming apparatus according to claim 25, wherein the premixed fuel supplying portion includes a premixed fuel temperature increasing portion which increases a temperature of the premixed fuel using heat of the gas containing hydrogen, generated by the reforming reaction before spraying the premixed fuel into the vaporizing portion.

25 27. The fuel reforming apparatus according to claim 22, further comprising:

an independent material supplying portion which supplies the reformer with independent material that contains one of the reformed fuel and the water and that does not contain the other, independently of the premixed fuel supplying portion.

30

28. The fuel reforming apparatus according to claim 27, wherein the independent material contains water, and the water contains water generated in a system including the fuel reforming apparatus.

5 29. The fuel reforming apparatus according to claim 28, wherein the independent material supplying portion includes:

a gas supplying portion which supplies the reformer with gas containing oxygen; and

10 a humidifying portion which adds the water generated in the system in a form of steam to the gas containing oxygen, that is to be supplied by the gas supplying portion to the reformer.

30. The fuel reforming apparatus according to claim 29, wherein the humidifying portion includes:

15 a first passage through which the gas containing oxygen flows;

a second passage through which the water generated in the system flows in a form of steam; and

20 a hydrogen permeable membrane which is provided between the first passage and the second passage, and through which steam permeates from a side in which steam partial pressure high to a side in which steam partial pressure is low.

31. The fuel reforming apparatus according to claim 22, wherein the premixed fuel storing portion makes a ratio of the number of molecules of the water in the premixed fuel with respect to the number of carbon atoms in the reformed fuel at least 0.5.

32. The fuel reforming apparatus according to claim 22, wherein the premixed fuel storing portion makes a ratio of the number of molecules of the water in the premixed fuel with respect to the number of carbon atoms in the reformed fuel at most 1.0.

33. The fuel reforming apparatus according to claim 22, wherein the premixed fuel supplying portion includes:

5 a premixed fuel temperature increasing portion which increases a temperature of the premixed fuel stored in the premixed fuel storing portion using heat of gas containing the hydrogen generated by the reforming reaction; and

a vaporizing portion which vaporizes the premixed fuel whose temperature has been increased in the premixed fuel temperature increasing portion before supplying the premixed fuel to the reformer.

10 34. A fuel cell system, comprising:

the fuel reforming apparatus according to claim 22; and
a fuel cell which generates an electromotive force by an electrochemical reaction using hydrogen generated in the fuel reforming apparatus.

15 35. A fuel cell system, comprising:

the fuel reforming apparatus according to claim 28; and
a fuel cell which generates an electromotive force by an electrochemical reaction using hydrogen generated in the fuel reforming apparatus,
wherein the water supplied from the independent material supplying
20 portion contains water generated in the fuel cell.

36. The fuel cell system according to claim 35, wherein the water supplied from the independent material supplying portion contains water in exhaust gas emitted from an anode side of the fuel cell.

25 37. The fuel cell system according to claim 35, wherein the water supplied from the independent material supplying portion contains water in exhaust gas emitted from a cathode side of the fuel cell.

30 38. The fuel cell system according to claim 35, further comprising:

a first combustion portion which burns hydrogen that remains in exhaust gas emitted from an anode of the fuel cell, wherein the water supplied from the independent material supplying portion contains water generated in the first combustion portion.

5

39. The fuel cell system according to claim 35, further comprising:

a hydrogen separating portion which includes a hydrogen permeable membrane that selectively makes hydrogen permeate therethrough, and which separates hydrogen in gas emitted from the fuel reforming apparatus using the hydrogen permeable membrane;

10

a hydrogen supplying portion which supplies the fuel cell with the hydrogen separated in the hydrogen separating portion; and

a second combustion portion which burns gas that remains after separation of hydrogen in the hydrogen separating portion, wherein the water supplied from the independent material supplying portion contains water generated in the second combustion portion.

15

40. A fuel cell system, comprising:

the fuel reforming apparatus according to claim 26; and

20

a fuel cell which generates an electromotive force by an electrochemical reaction, wherein the fuel reforming apparatus includes a hydrogen extracting portion having a hydrogen permeable membrane which selectively makes hydrogen permeate therethrough, and extracts hydrogen from gas containing hydrogen using the hydrogen permeable membrane by being supplied with the gas containing hydrogen generated in the reformer, and operates at a temperature that is higher than that of the fuel cell, and the premixed fuel temperature increasing portion increases a temperature of the premixed fuel using the hydrogen extracted by the hydrogen extracting portion, and supplies the hydrogen used for increasing the premixed fuel for the electrochemical reaction in the fuel cell.

25

30

41. A fuel cell system, comprising:

the fuel reforming apparatus according to claim 33; and

a fuel cell which generates an electromotive force by an electrochemical reaction, wherein the fuel reforming apparatus includes a hydrogen extracting portion having a hydrogen permeable membrane which selectively makes hydrogen permeate therethrough, and extracts hydrogen from gas containing hydrogen using the hydrogen permeable membrane by being supplied with the gas containing hydrogen generated in the reformer, and operates at a temperature that is higher than that of the fuel cell, and the premixed fuel temperature increasing portion increases a temperature of the premixed fuel using the hydrogen extracted by the hydrogen extracting portion, and supplies the hydrogen used for increasing the premixed fuel for the electrochemical reaction in the fuel cell.